

TACMINA

Smoothflow Pump



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Smoothflow Pumps for Continuous, Precise Transferring of Minute Amounts in Lab Settings



Milliliter Class



Microliter Class

World-First Mechanism
Patented

Are you and your conventional laboratory pump plagued with problems like these?



Tube type

Low accuracy and reduced flow rate

The structure of conventional pumps makes strict flow control difficult. Over time, tube elasticity decreases, making it impossible to achieve original flow rates.

High running costs

Special tubes for organic solvents in particular wear out quickly, and components are generally expensive, leading to higher running costs.



Syringe type

Continuous, long-term liquid transfer is impossible

Multi-type apparatuses are required for continuous transferring of liquids beyond the capacity of the syringe. Pulsation arises when switching from one syringe to the next.

Scaling up is difficult

Revalidation using pumps from another system is necessary when transitioning to actual production.



Plunger type

Severe wear

Plunger wear leads to decreases in performance and improper discharges. Abrasion debris can mix into the liquid, contributing to contamination.

Liquid leakage

Liquid can begin to leak from the seals. This can be problematic with dangerous chemicals and liquids that solidify or deteriorate when exposed to air.

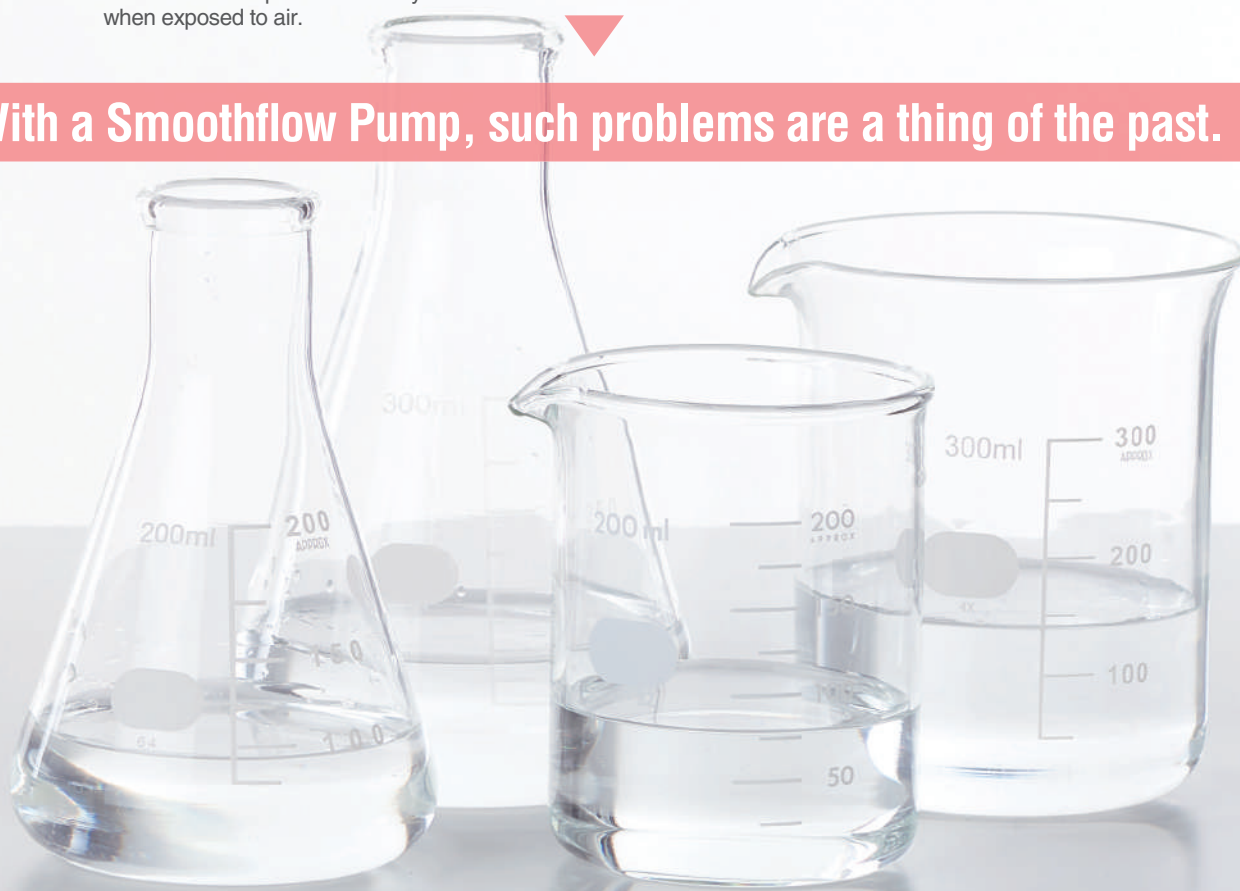


Diaphragm type
(Single pump head)

Excessive pulsation

Reciprocating pumps cause intermittent flow with pulsations. Installation of a pulsation damper is required.

With a Smoothflow Pump, such problems are a thing of the past.



For Those Who Want Total Control over Liquid Flow

Smoothflow — the ideal method of liquid transfer. This innovative method not only meets your liquid transfer needs, but also provides optimal solutions to people, liquids and the environment as well. TACMINA's Smoothflow technology, based on unique know-how cultivated over 50 years, delivers you ultimate performance and provides complete satisfaction.

Ideal Method of Liquid Transfer

Smoothflow

- Constant & Stable Flow
- Eco-Friendly
- Economical
- Gentle on Liquids

Pumping performance and reliability that exceeds conventional laboratory pump's limitations

Smoothflow Pumps—designed for state-of-the-art manufacturing processes requiring extremely high precision, including applications for thin film coating and pharmaceutical manufacturing.

The Q Series is the first pump that brings TACMINA's Smoothflow technology to the laboratory.

Excellent quantitative performance and responsiveness

- The Q series pumps provide impressive quantitative performance with repeatability within $\pm 1\%$ (F.S.)*1. *1 For the Q-100.
- Flow rates can be finely configured at units of 0.01 mL/min (1 μ L/min for the Q-5).
- In addition, the excellent responsiveness allows for quick enforcement of starting and stopping operations and flow rate change operations.

★ Five models selectable according to flow rate and discharge pressure

	Model	Flow rate	Maximum discharge pressure
Milliliter Class	Q-100	0.1 to 100 mL/min	0.3 MPa
	Q-60	0.1 to 60 mL/min	0.6 MPa
	Q-30	0.1 to 30 mL/min	1.0 MPa
	Q-10	0.1 to 10 mL/min	2.0 MPa
Microliter Class	Q-5	5 to 5000 μ L/min	3.0 MPa



Watch sample transfer videos.

www.tacmina.com/Q



Pumping demo



Flow rate change operation



Auto-stop operation

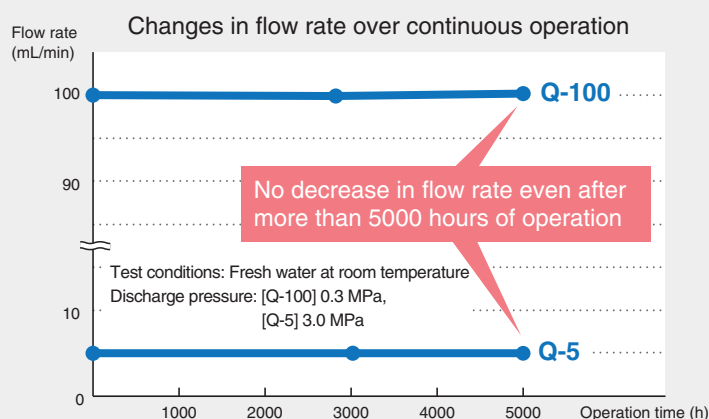


In-line mixing



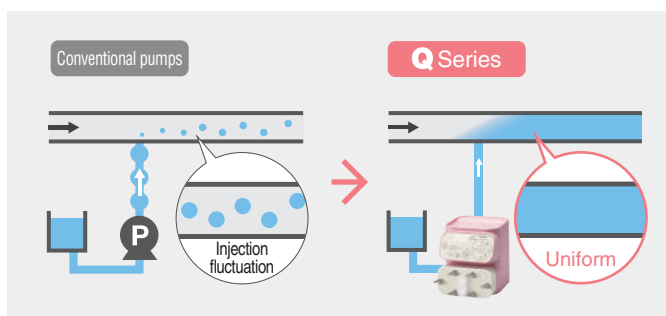
Ability to maintain pumping accuracy over long periods of time

- Since there are no sliding parts, the load applied to the liquid-end section is small, preventing component wear and decreases in flow rate even over long-term use.
- In other words, the service life of the components is longer and running costs are low.



Continuous, constant flow with no pulsation

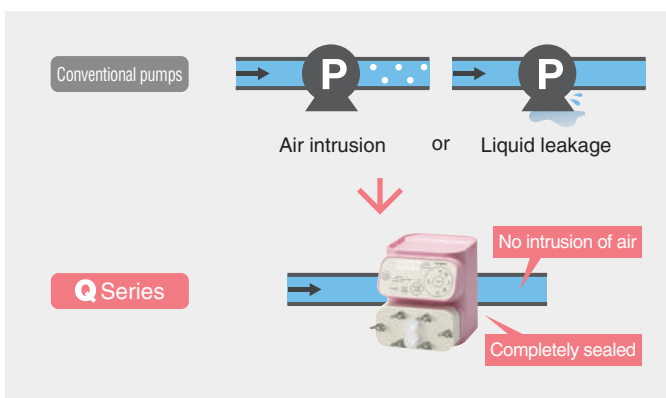
- TACMINA's proprietary pumping mechanism (patented) enables pulsation-free, continuous, constant flow even with diaphragm pumps.



No liquid leakage or changes in properties

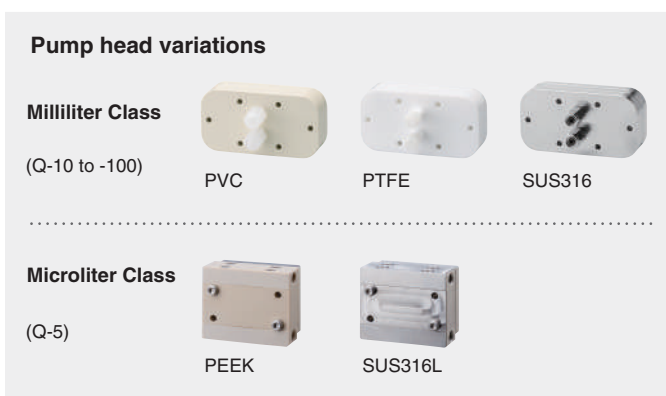
- Since no sliding parts are used, localized pressure does not change, liquid is not altered by frictional heat, and solidification is prevented.
- The completely sealed structure eliminates the need to worry about liquid leakage or contact with outside air.
- Water-reactive substances*2 and other delicate liquids that may be altered if exposed to air can also be conveyed with no changes to the liquid properties.

*2 Conditions apply. For details, contact TACMINA.



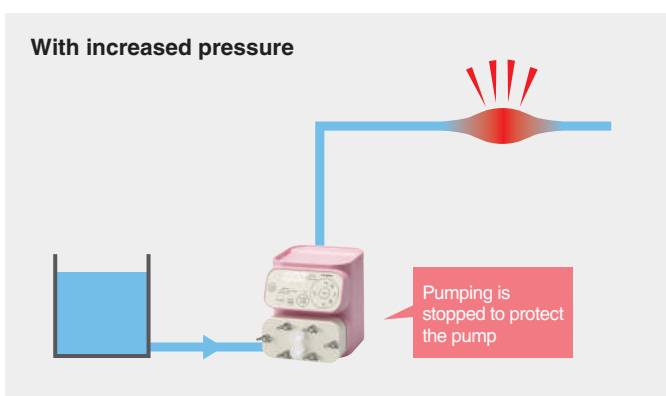
Capable of handling a wide variety of chemicals

- Liquid-end materials with a high corrosion resistance are available to suit the properties of the liquid being used, including acids, alkalis, and organic solvents.
- A model whose entire liquid-end section can be sterilized with an autoclave is also available.



Not damaged by clogged piping or dry running

- No load is applied to the pump even when the pump is obstructed, such as when the valve fails to open or clogging occurs, so there's no need to worry about malfunctions.
- The absence of sliding parts means there's no need to worry about galling, seizing, wear, or damage even with dry running.



Simple, user-oriented design for ease of use

Easy setting and calibration

- Users can change the flow rate just by entering the desired rate.
- Pump calibration can also be performed just by measuring and inputting the actual discharge rate. This allows for easy and accurate flow control.



Simple disassembly and assembly

- The liquid-end section can be disassembled just by removing the bolts.
- Since assembly can be performed without trouble even for the first time, anyone can assemble the pump and maintain original performability.



Easy liquid change

- With a spare pump head set, the liquid can be switched quickly just by replacing the pump head.
- Users can also use pump heads for fluids requiring the use of different head materials.



I/O control, gradient operation and other various functions



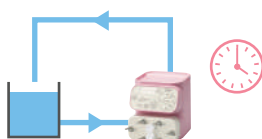
Auto-stop operation

Q

Operation times and discharge amounts can be set to stop pump operation automatically.

Example 1

Stopping the pump after pumping for 2 hours



Example 2

Stopping the pump after pumping 500 mL



Signal output function

QI, QT

Signals can be output for use with external equipment.

Unit pulse	Pulse signal output after a specific amount is discharged
Alarm	Signal output when an error occurs
Operation signal	Signal output while the pump is in operation
Stop end signal	Pulse signal output when interval or gradient operation ends (QT only)



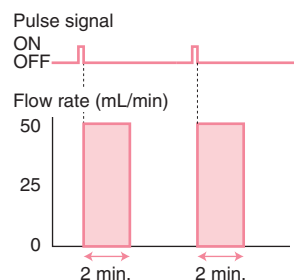
Pulse-input proportional operation

QI

Pumps can be operated automatically depending on a pulse signal input from an external device.

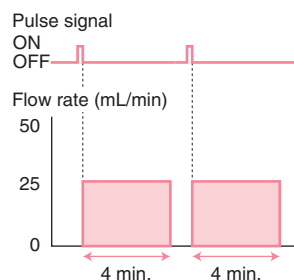
Example 1

100 mL discharged at 50 mL/min per pulse signal



Example 2

100 mL discharged at 25 mL/min per pulse signal



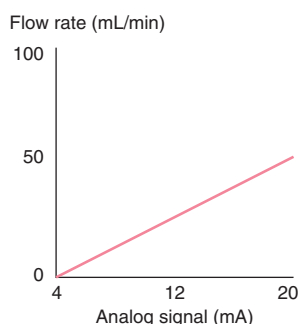
Analog-input proportional operation

QI

The flow rate can be changed automatically relative to an analog signal (4 to 20 mA DC) input from an external device.

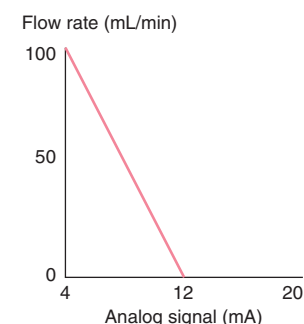
Example 1

Flow rate control between 0 and 50 mL/min for signals between 4 and 20 mA



Example 2

Flow rate control between 100 and 0 mL/min for signals between 4 and 12 mA



Interval operation

QT

Pump operation can be turned ON and OFF at regular intervals repeatedly.

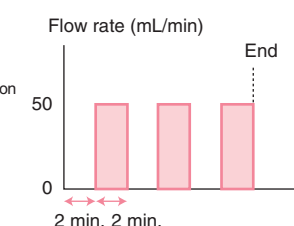
Example 1

Operation at a flow rate of 50 mL/min starting after 3 minutes and stopping after 2 minutes performed repeatedly



Example 2

Operation at a flow rate of 50 mL/min starting after 2 minutes and stopping after 2 minutes performed 3 times and then stopped



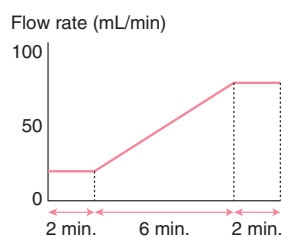
Gradient operation

QT

The flow rate of a pump can be gradually increased or decreased in proportion to how much operating time has passed.

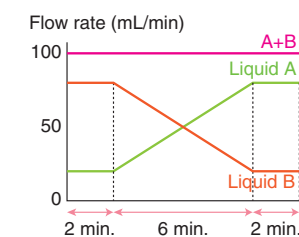
Example 1

After 2 minutes of operation at 20 mL/min, flow rate increased to 80 mL/min over 6 minutes with 2 minutes of operation at 80 mL/min



Example 2

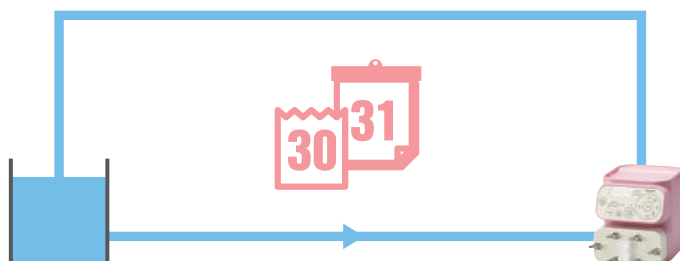
Gradient operation with positive symmetry using 2 linked pumps (constant total flow rate)



* Q: Standard type / QI: I/O signal control type / QT: Timer control type For more information, see "Model Selection Guide" on pages 11 and 13.

Application Examples

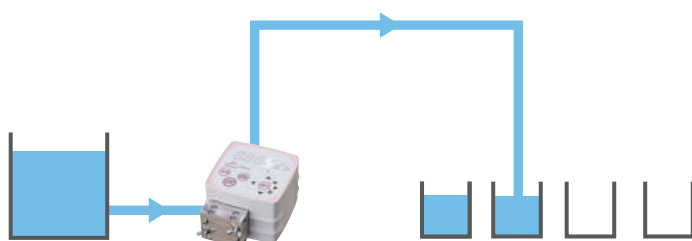
Continuous operation over extended periods



Long-term continuous operation is possible for durability tests. Thanks to a structure that incorporates no sliding parts for transferring, the flow rate does not decrease due to wear or the like even over long periods.

- Control types: Q, QI, QT
- Functions: Manual operation

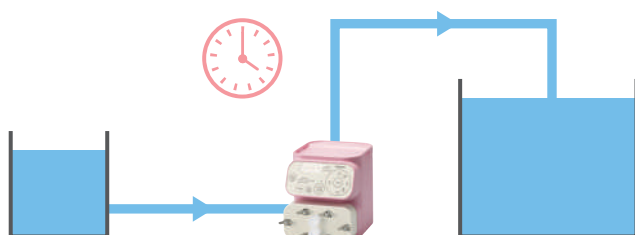
Dispensing



Operation automatically stops following discharge of a specified amount of liquid. This functionality is useful when collecting a fixed amount of a liquid.

- Control types: Q, QT
- Functions: Auto-stop or interval operation

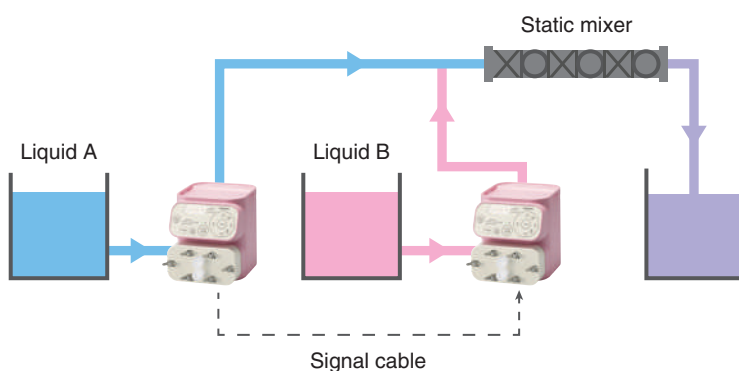
Constant-cycle injection



Operation can be performed and stopped at a constant cycle. Regular injection operations can be performed automatically and with no user input.

- Control types: QT
- Functions: Interval operation

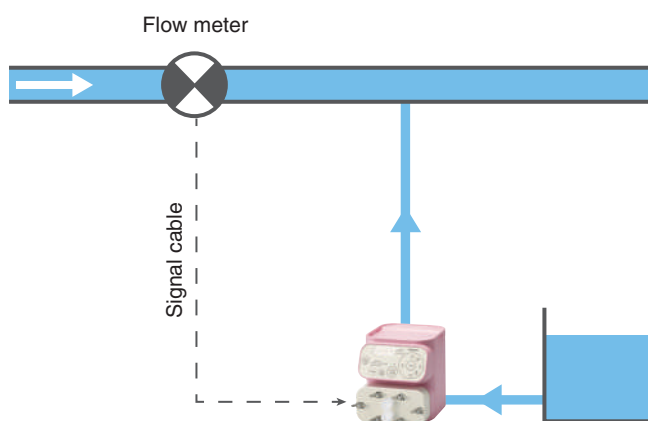
Gradient mixing



When two or more pumps are linked together, mixing can be performed while gradually changing the ratio of liquids. (Consult TACMINA for applications requiring six or more pumps.)

- Control types: QT
- Functions: Gradient operation

Flow-proportional injection



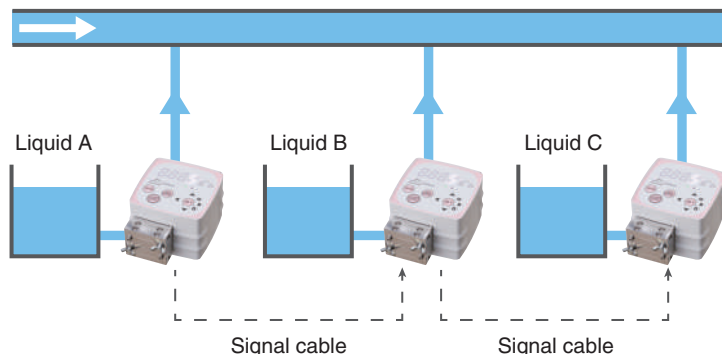
In accordance with the flow rate in the main piping being measured by the flow meter, the amount of chemical to be injected can be adjusted automatically by inputting a signal to the pump.

- Control types: QI
- Functions: Pulse-input or analog-input proportional operation

[Tip]

Control proportional to a liquid's chemical concentration, pH value, or temperature is also possible.

Linked transfer of multiple liquids

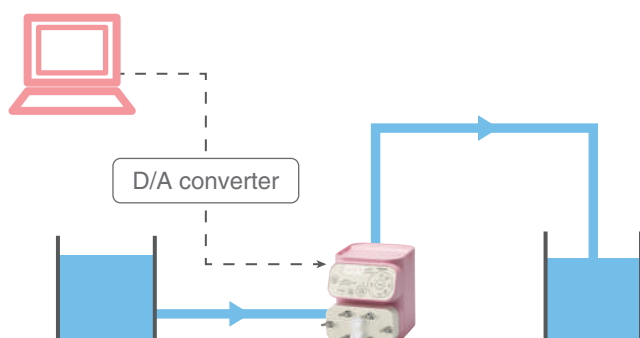


The transfer amounts of multiple pumps can be linked by outputting a unit pulse for each constant discharge rate and then inputting that pulse to another pump.

For example, this functionality makes it possible to control the pumps so that 5 mL of liquid B is injected for every 10 mL of liquid A that is injected.

- Control types: QI
- Functions: Unit pulse signal output and pulse-input proportional operation

Program control



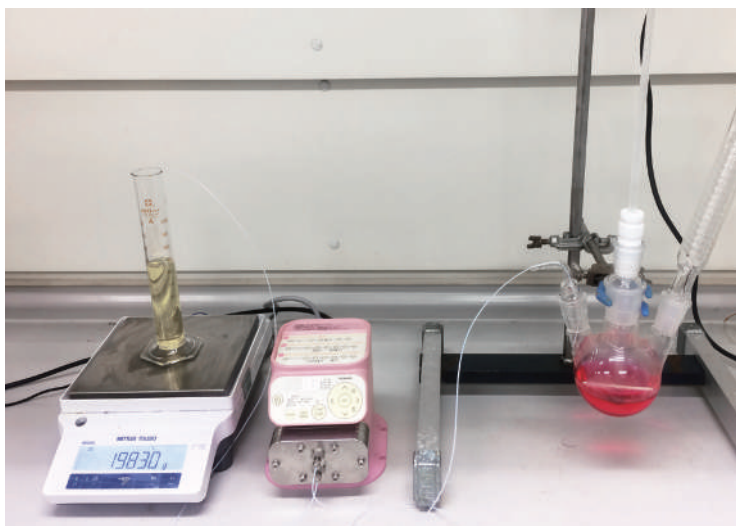
Using commercially available system development software allows for complex flow control that suits the desired purpose.

- Control types: QI
- Functions: Analog-input proportional operation

Actual Case Studies

case 01 Major chemical manufacturer

Easy and accurate dispensing of micro-drops not easily achieved with syringe pumps



Customer's needs and problems

Isocyanate is dripped into alcohol in urethane synthesis tests.

- ✓ Conventional system with syringe pumps
- ✓ Excessive time required for pump preparation
- ✓ Flow rate changes over time

Solution!

- ✓ Accurate configuration of drip amount
- ✓ Easy preparation and configuration of flow rate settings
- ✓ Constant flow rate even during long-term continuous operation

case 02 National university

Continuous synthesis with water-reactive butyllithium



Customer's needs and problems

The chemical (BuLi) is supplied to a microreactor during tests of organic synthesis.

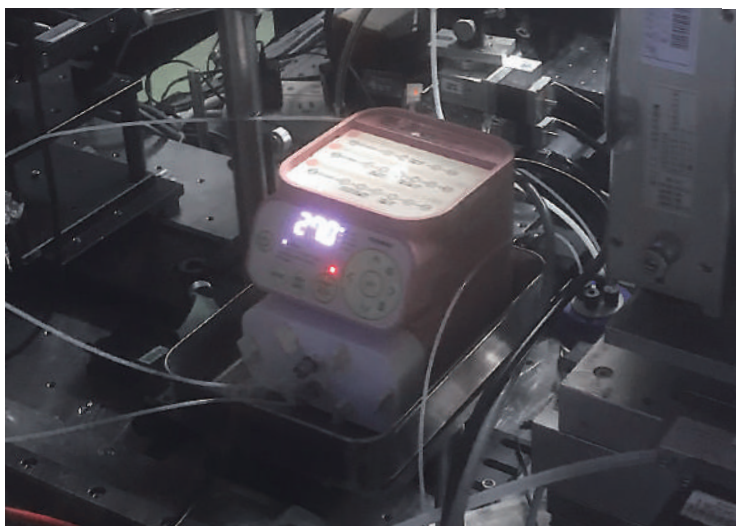
- ✓ Strict control of the reaction required
- ✓ Liquid should not be exposed to air
- ✓ Transferring with no crystallization of the liquid needed

Solution!

- ✓ Continuous, constant flow with no pulsation for precise liquid transfer
- ✓ Sealed structure means no liquid leakage
- ✓ Transferring without crystallization

case 03 National research institute

Stable transfer of sample solution ensures accurate observation data



Customer's needs and problems

A solution containing a photocatalyst is transferred, and X-rays are applied to observe atomic reactions.

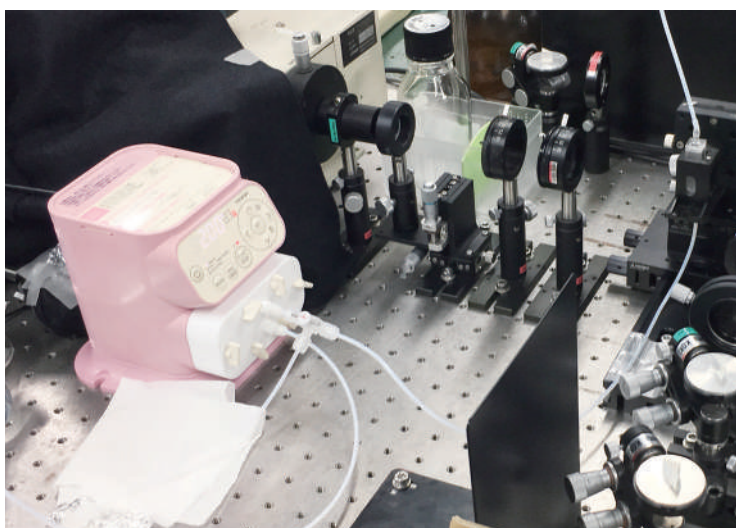
- ✓ Transferring of organic solvents required
- ✓ Data quality reduced due to pulsation
- ✓ Excessive use of precious sample solution

Solution!

- ✓ Liquid-end materials designed for organic solvents
- ✓ Continuous, constant flow with no pulsation
- ✓ Testing with small amounts of liquid

case 04 Private university

Ability for long-term, spectroscopic measurements that were not possible with syringe pumps



Customer's needs and problems

Organic solvents including pharmaceutical materials are transferred with a pump, and measurement is performed with spectroscopy.

- ✓ Need for long-term, continuous measurement
- ✓ Limited syringe pump capacity
- ✓ Pump adjustments take too much effort

Solution!


- ✓ Long-term, stable liquid transfer
- ✓ No limits on liquid transfer amounts
- ✓ Reduced adjustment time required

Model Selection Guide <Milliliter Class>

Model code


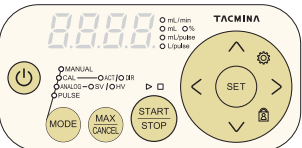
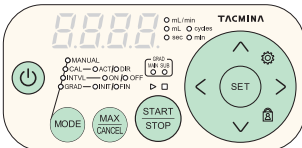
Q – **100** – **VE** – **ULP** – **E** **S**^{*1}

1 Control type 2 Model (flow rate) 3 Liquid-end material 4 Power plug Language General specifications



*1 If manufactured with special specifications, this will be "X".

1 Select control type.

Name	Q (Standard type)	QI (I/O signal control type)	QT (Timer control type)
Operation panel			
Operation mode	<ul style="list-style-type: none"> Manual operation Calibration Auto-stop operation 	<ul style="list-style-type: none"> Manual operation Calibration Analog-input proportional operation Pulse-input proportional operation 	<ul style="list-style-type: none"> Manual operation Calibration Interval operation Gradient operation





2 Select model (flow rate).

Name	100	60	30	10
Flow rate	0.1 to 100 mL/min	0.1 to 60 mL/min	0.1 to 30 mL/min	0.1 to 10 mL/min
Maximum discharge pressure	0.3 MPa	0.6 MPa	1.0 MPa	2.0 MPa

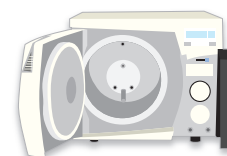
Model and material combination

	100	60	30	10
VE	●	—	—	—
VF	●	—	—	—
TT	●	●	—	—
6T	●	●	●	●

3 Select liquid-end material.

Name	VE	VF	TT	6T
Shape				
Pump head	PVC	PVC	PTFE	SUS316
Diaphragm	PTFE/CR	PTFE/CR	PTFE/CR	PTFE/CR
Sheet valve and packing	EPDM	Special fluoro rubber	Special fluoro rubber (perfluoro [FFKM])	Special fluoro rubber (perfluoro [FFKM])
Joint	PP	PP	PTFE	SUS316

A type that supports autoclave sterilization is also available.



* Contact TACMINA for details.

4 Select power plug.

Name	ULP	AUP	EUP	UKP	JPL
Shape	 UL plug	 Australia plug	 EU plug (CE)	 UK plug (CE)	 Lead wire

Specifications <Milliliter Class>

Pump specifications

Specifications		Model	Q, QI, QT				
		100	60	30	10		
Maximum flow rate*2	mL/min	100	60	30	10		
	L/h	6	3.6	1.8	0.6		
	US G/h	1.58	0.95	0.47	0.15		
Flow rate control range		Variable from 0.1 to the maximum flow rate					
Maximum discharge pressure	MPa	0.3	0.6	1	2		
	bar	3	6	10	20		
	psi	43.5	87	145	290		
Reproducibility		±1% (F.S.)					
Connection diameter		φ4 × φ6 (R 1/8)					
Ambient temperature*3		0 to 40					
Transfer liquid temperature	°C	0 to 40 (no freezing)					
		0 to 60 for the Q□-100-6T depending on the conditions (no freezing)*4					
Transfer liquid viscosity		mPa·s		200 or less		100 or less	
Environmental resistance		IEC standard: Corresponds to IP65 (dust proofing and waterproofing)					
Power supply	Rated voltage	100 to 240 VAC ±10%					
	Phase/frequency	1 φ / 50 Hz or 60 Hz					
	Cord	2 m					
Weight*5 *6		VE / VF: 1.6, TT: 1.7*7, 6T: 2.5*8					

*2 Conditions: Clean water at room temperature.

*3 -10 to 50°C during transportation and storage.

*4 Contact TACMINA for the conditions.

*5 The weight of the stand is excluded. *6 This is the weight of the Q (standard type).

*7 This is the weight of the Q-100. The weight of the Q-60 is 1.8 kg.

*8 This is the weight of the Q-100. Q-60/30's is 2.6 kg. Q-10's is 2.9 kg.

Control functions

Function	Description	Q	QI	QT
Manual operation	Setting possible in units of 0.1 mL/min or 0.01 mL/min	●	●	●
Auto-stop operation	Operating time: 1 to 9999 seconds or 1 to 9999 minutes Discharge volume: 0.1 to 999.9 mL or 0.1 to 999.9 L	●	—	—
Pulse-input proportional operation	0.1 to 999.9 mL/pulse or 0.1 to 999.9 L/pulse	—	●	—
Analog-input proportional operation	Controllable according to set target value (SV) and max. flow rate (HV)	—	●	—
Interval operation	Flow: 0.1 mL to MAX (0.1 mL units) ON time / OFF time: 1 to 9999 seconds or 1 to 9999 minutes	—	—	●
Gradient operation	Flow: 0.1 mL to MAX (0.1 mL units) Time: 1 to 9999 seconds or 1 to 9999 minutes (Initial retention time, gradient time, final retention time)	—	—	●

I/O signal specifications (QI and QT only)

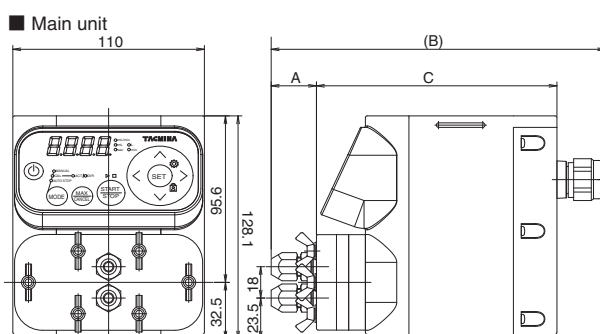
Signal		QI	QT
Analog	Input	1 port 4 to 20 mA DC Input resistance: Approximately 110 Ω	—
	Output	2 ports No-voltage contact or open collector*9 Maximum pulse count: 6000 pulses/min Minimum pulse width: 5 msec (ON time) Assigned to one of the following: Pulse, pause/run, level, or MAX operation	2 ports No-voltage contact or open collector*9 Maximum pulse count: 6000 pulses/min Minimum pulse width: 5 msec (ON time) Assigned to one of the following: Start, pause/run, level, or MAX operation
Digital	Input	2 ports No-voltage contact or open collector*9 Maximum pulse count: 6000 pulses/min Minimum pulse width: 5 msec (ON time) Assigned to one of the following: Pulse, pause/run, level, or MAX operation	2 ports No-voltage contact or open collector*9 Maximum pulse count: 6000 pulses/min Minimum pulse width: 5 msec (ON time) Assigned to one of the following: Start, pause/run, level, or MAX operation
	Output	2 ports 25 VDC, 10 mA or less Assigned to one of the following: Unit pulse, alarm, or operation signal	2 ports 25 VDC, 10 mA or less Assigned to one of the following: Unit pulse, end signal, alarm, or operation signal

*9 Make sure the residual voltage of the open collector does not exceed 1 V.

Accessories

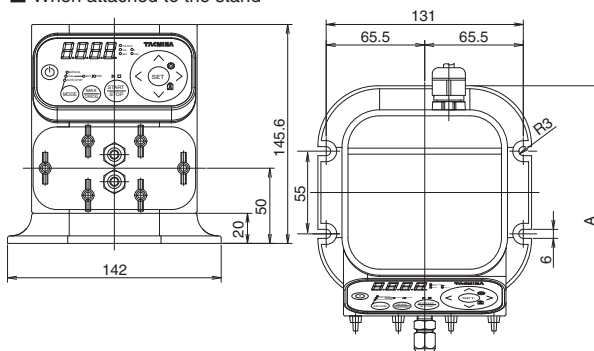
Tube (φ4 × φ6)	2 m	Pump stand set	×1
* VE / VF: Polyolefin resin, TT / 6T: PTFE		* A pump stand with machine screws	
Syringe (24 mL)	×1	Mounting bolt set	×4
Nonslip sheet	×1	* Hexagon bolts and nuts	
		Operation manual	×1

External dimensions



	Q-100				Q-60		Q-30	Q-10
	VE	VF	TT	6T	TT	6T	6T	6T
A	26		22		26	22	22	22
B	192		188		192	188	184	190
C	138.1		137.6		137.6	137.6	134.4	139.9

When attached to the stand



	Q-100		Q-60		Q-30	Q-10
	VE, VF, TT	6T	TT	6T	6T	6T
A	179.1	175.1	179.6	175.1	172.4	177.9

Consumables (per pump)

Part name	Quantity	Recommended replacement interval
Diaphragm	2	4000 hours or 1 year
Sheet valve	1	
Packing	1	
Protective sheet	1	When deterioration or damage is visible

Model Selection Guide <Microliter Class>

Model code

Q – **5** – **KR** – **UP** – **E** **S**^{*1}

1 Control type 2 Model (flow rate) 3 Liquid-end material 4 Power plug Language General specifications



*1 If manufactured with special specifications, this will be "X".

1 Select control type.

Name	Q (Standard type)	QI (I/O signal control type)
Operation panel		
Operation mode	<ul style="list-style-type: none"> Manual operation Calibration Auto-stop operation 	<ul style="list-style-type: none"> Manual operation Calibration Analog-input proportional operation Pulse-input proportional operation

2 Model (flow rate)

Name	5
Flow rate	5 to 5000 $\mu\text{L}/\text{min}$
Maximum discharge pressure	3.0 MPa

3 Select liquid-end material.

Name	KR	6R
Shape		
Pump head	PEEK	SUS316L
Diaphragm	PTFE/CR	PTFE/CR
Check ball	Ruby	Ruby
Valve seat	Sapphire	Sapphire
Packing	PTFE	PTFE

4 Power plug

Name	UP
Shape	 Universal plug (compatible with A/C/BF/O-type power outlets)

Lead wire specifications are also available.

* Contact TACMINA for details.

Specifications <Microliter Class>

Pump specifications

Specifications		Model	Q, QI-5
Maximum flow rate*2	μL/min		5000
	L/h		0.3
	US G/h		0.07
Flow rate control range	μL/min		5 to 5000
Maximum discharge pressure	MPa		3
	bar		30
	psi		435
Connection type			1/4-28UNF
Connection diameter			φ1/16" × φ1/8"*3
Ambient temperature*4	°C		0 to 40
Transfer liquid temperature	°C		0 to 40 (no freezing)
Transfer liquid viscosity	mPa·s		50 or less
Environmental resistance			IEC standard: Corresponds to IP65 (dust proofing and waterproofing)
Power supply	Rated voltage		100 to 240 VAC ±10%
	Phase/frequency		1 φ / 50 Hz or 60 Hz
	Cord		1.8 m
Weight	kg		KR: 0.74, 6R: 0.92

*2 Conditions: Clean water at room temperature.

*3 Contact TACMINA for applications with different sizes of fittings and tubes.

*4 -10 to 50°C during transportation and storage.

Control functions

Function	Description	Q	QI
Manual operation	Setting possible in units of 1 μL/min	●	●
Auto-stop operation	Operating time: 1 to 9999 seconds or 1 to 9999 minutes Discharge volume: 1 to 9999 μL or 1 to 9999 mL	●	—
Pulse-input proportional operation	1 to 9999 μL/pulse or 1 to 9999 mL/pulse	—	●
Analog-input proportional operation	Controllable according to set target value (SV) and max. flow rate (HV)	—	●

I/O signal specifications (QI only)

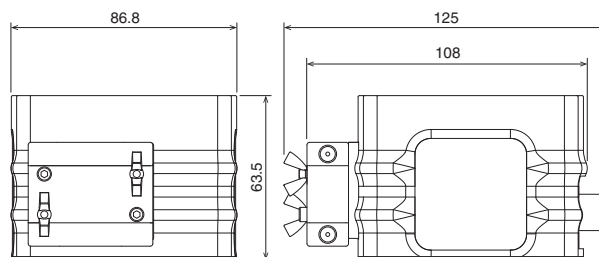
Signal		QI
Analog	Input	1 port 4 to 20 mA DC Input resistance: Approximately 110 Ω
	Output	2 ports 25 VDC, 10 mA or less Assigned to one of the following: Unit pulse, alarm, or operation signal

*5 Make sure the residual voltage of the open collector does not exceed 1 V.

Accessories

Tube ······ 2 m (PTFE, φ1/16" × φ1/8")	AC adapter ······ ×1 (with A/C/O/BF plugs)
Syringe set ······ ×1	Signal cable (QI only) ······ 1.5 m
Joint assembly (ETFE) ······ ×2	Allen wrench ······ ×1 (2.5 mm across flats)
Nonslip sheet ······ ×1	Operation manual ······ ×1

External dimensions



Consumables (per pump)

Part name	Quantity	Recommended replacement interval
Diaphragm	2	4000 hours or 1 year
Check ball / valve seat assembly	4	
Packing	8	

The next level of Smoothflow Pumps for applications that call for more performance

XPL

The same excellent precision and ease of use as the Q Series!

Continuous, constant flow with no pulsation

Excellent quantitative performance

Easy disassembly and maintenance

PVC, PTFE, and SST liquid-end parts



Maximum discharge volume: 0.01 to 3 L/min
Maximum discharge pressure: 1.5 MPa



Scaling up

Achieve flow rates of up to 3 L/min and discharge pressures as high as 1.5 MPa.



Slurries and high-viscosity liquids

Get smooth, trouble-free transfers of abrasive slurries and liquids with high viscosities up to 2000 mPa·s.



Explosion proof

Take advantage of the optional explosion-proof motor (d2G4).



Sanitary

Sanitary types are also available for food, medicine, fine chemicals, and other applications.

Pumps for microreactors and other high-pressure, high-precision applications

TPL

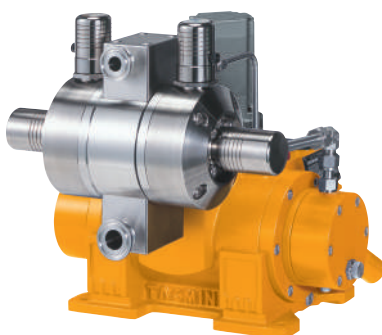
Suitable for applications requiring high liquid transfer capacities and safety, from laboratories to commercial facilities

Ultra-precise liquid transfers with no pulsation

Repeatability accuracy within $\pm 0.1\%$

High-pressure support up to 15 MPa

Built-in relief mechanism for safe operation



Maximum discharge volume: 0.1 to 30 L/min
Maximum discharge pressure: 15 MPa

Smoothflow System

Combine pumps, tanks, and control devices to design and manufacture equipment and systems that suit your needs.



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Product designs and specifications are subject to change without notice for product improvement.

EC-069(1)-

2020/2/D--